I - SYSTEM/COMPONENT TESTS - 2.2L

1997 ENGINE PERFORMANCE General Motors Corp. - System & Component Testing - 2.2L 2WD

INTRODUCTION

Before testing separate components or systems, perform procedures in the **BASIC TESTING - 2.2L** article. Since many computer-controlled and monitored components set a trouble code if they malfunction, also perform procedures in the **TESTS W/CODES - 2.2L** article.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests with a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter and refer to the WIRING DIAGRAMS article to isolate wiring harness shorts or opens.

The following table provides the location of commonly used diagnostic information.

GENERAL MOTORS REFERENCE

System Or Component	Diagnostic Information Location
Malfunction Indicator Light (MIL)	See ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK in **BASIC TESTING - 2.2L** article
DLC & MIL On Steady	See ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK in **BASIC TESTING - 2.2L** article
No Scan Tool Data	See ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK in **BASIC TESTING - 2.2L** article
No-Start Diagnosis	See appropriate NO-START - ENGINE CRANKS OKAY in **BASIC TESTING - 2.2L** article
Injector Circuit Diagnosis	See BASIC FUEL SYSTEM CHECKS in **BASIC TESTING - 2.2L** article
Fuel Pump Relay	See **MODULES, MOTORS, RELAYS & SOLENOIDS**
Fuel System Diagnosis	See appropriate BASIC FUEL SYSTEM CHECKS in **BASIC TESTING - 2.2L** article
Injector Balance Test	See **FUEL SYSTEM**
MAP Sensor	See **ENGINE SENSORS & SWITCHES**
Transmission Range Switch	See **ENGINE SENSORS & SWITCHES**
IAC Valve	See **IDLE CONTROL SYSTEM** under FUEL SYSTEM
Fuel Evaporation Control	See **EMISSION SYSTEMS & SUB-SYSTEMS**
Ignition Control Circuit	See **IGNITION SYSTEM**
Knock Sensor Check	See **IGNITION SYSTEM**
EGR System	See **EMISSION SYSTEMS & SUB-SYSTEMS**

Torque Converter Clutch	See **MISCELLANEOUS PCM/VCM CONTROLS**
Manual Transmission Shift Lights	See **MISCELLANEOUS PCM/VCM CONTROLS**
A/C Clutch Control	(1) See **MISCELLANEOUS PCM/VCM CONTROLS**
Electric Cooling Fan Control	(1) See **MISCELLANEOUS PCM/VCM CONTROLS**
(1) Complete coverage in the A/C-HEATER SYSTEM article in the AIR CONDITIONING & HEAT section.	

COMPUTERIZED ENGINE CONTROLS

CONTROL UNIT

NOTE: To perform the following ground and power tests, use appropriate wiring diagram in the WIRING DIAGRAMS article.

Ground Circuits

1. Using an ohmmeter, check for continuity to ground on PCM/VCM ground terminals. Resistance should be zero ohms. If not, repair open to ground.
2. Using a voltmeter, touch negative lead of voltmeter to a good ground. Touch positive lead of voltmeter to each ground terminal. With vehicle running, voltmeter should indicate less than one volt. If voltmeter reading is more than one volt, check for open, corrosion or loose connection on ground circuit.

Power Circuits

1. Using a voltmeter, check for battery voltage between PCM/VCM continuous power terminal(s) and ground. If battery voltage is not present, check for blown fuse or open fusible link. If okay, check for open in wire between PCM/VCM terminal and power source.
2. Turn ignition on. Using a voltmeter, check for battery voltage between PCM/VCM ignition power terminals and ground. If battery voltage is not present, check IGN fuse. If fuse is okay, check for an open in wire between battery and ignition switch, and between ignition switch and PCM/VCM terminal. If okay, check for a defective ignition switch.
3. Connect voltmeter between ground and PCM/VCM starter (crank) signal terminal. On vehicles with manual transmission/transaxle, depress clutch pedal. Turn ignition switch to START position. Battery voltage should be present ONLY when ignition switch is in START position.
4. If voltage is not present, check CRANK fuse or fusible link between ignition switch and PCM/VCM terminal. If fuse or fusible link is okay, check for an open in wire between ignition switch and PCM/VCM terminal, or check for a defective ignition switch.

ENGINE SENSORS & SWITCHES

A/C ON SWITCH/SYSTEM TEST

1. Turn ignition switch to RUN position. Move mode selector switch to any position other than OFF position. With A/C control assembly connected, measure voltage between mode selector switch Light Green wire and ground. For wiring schematics, see the WIRING DIAGRAMS article.
2. Battery voltage should be present. If battery voltage is present, mode selector switch is operating normally. If battery voltage is not present, check wire from mode selector switch to fuse for an open circuit. Also check A/C high and low pressure switches for open.
3. Check voltage between mode selector switch Dark Green/White wire or Light Green wire and ground. Voltage should not be present. If voltage is present, replace mode selector switch.

BRAKE SWITCH

Disconnect brake switch harness connector. Using an ohmmeter, check continuity between brake switch terminals. Continuity should be present. Depress brake pedal or activate brake switch, continuity should not be present.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

If a coolant sensor-related code is present, see the **TESTS W/CODES - 2.2L** article. An out-of-calibration sensor may not set a trouble code. Use following procedure to test sensor calibration. Disconnect ECT sensor connector. Measure resistance between sensor terminals. Resistance should be high when engine is cold and drop as engine warms. See **ECT SENSOR RESISTANCE VALUES** table.

ECT SENSOR RESISTANCE VALUES

Temperature °F (°C)	Resistance (Ohms)
212 (100)	177
158 (70)	467
100 (38)	1800
68 (20)	3520
23 (-5)	12,300
0 (-18)	25,000
-40 (-40)	100,700

NOTE: Intake Air Temperature (IAT) sensor is also referred to as Manifold Air Temperature (MAT) sensor.

INTAKE AIR TEMPERATURE (IAT) SENSOR

If an IAT sensor-related code is present, see the **TESTS W/CODES - 2.2L** article. An out-of-calibration sensor may not set a trouble code. Use following procedure to test calibration. Disconnect IAT sensor harness connector. Connect ohmmeter between sensor terminals. Sensor resistance should be as specified. See **IAT SENSOR RESISTANCE** table. With vehicle sitting overnight, IAT sensor and coolant sensor should have close to the same resistance reading.

IAT SENSOR RESISTANCE

Temperature °F (°C)	Resistance (Ohms)
212 (100)	185
158 (70)	450
100 (38)	1800
68 (20)	3400
40 (4)	7500
20 (-7)	13,500
0 (-18)	25,000
-40 (-40)	100,700

KNOCK SENSOR

1. Disconnect knock sensor harness connector. Using an ohmmeter, measure knock sensor resistance between sensor terminal and engine block. Resistance should be 3300-4500 ohms. Connect voltmeter between sensor terminal and ground. Set voltmeter to 2-volt AC scale.
2. Start and idle engine. Tap on engine block near sensor. A signal should be indicated on voltmeter. If no signal is indicated, replace knock sensor. Also see **TIMING CONTROL SYSTEMS** under IGNITION SYSTEM and the **TESTS W/CODES - 2.2L** article.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

1. MAP sensor circuit malfunction should set a related code in PCM/VCM memory. If a code is present, see the **TESTS W/CODES - 2.2L** article. An out-of-calibration sensor may not set a trouble code. Use following procedure to test sensor calibration. If driveability problems exist, MAP sensor failure is suspected and no MAP code is present, disconnect MAP sensor connector. If driveability condition improves, check MAP vacuum hose for splits, kinks, proper routing and blockage. If no problems are found, replace MAP sensor.
2. With ignition on and engine off, check MAP sensor parameter using a scan tool connected to Data Link Connector (DLC). Voltage should be as specified in **MAP SENSOR VOLTAGE RANGE** table.
3. If MAP sensor voltage is as specified, go to next step. If voltage is not as specified, check 5-volt reference supply to sensor. Check harness integrity. If no problems are evident, replace MAP sensor.
4. Using a hand-held vacuum pump, apply 10 in. Hg to MAP sensor and note voltage change. Voltage should drop to about 1.0-2.5 volts less than specified in table. If voltage is not as specified or voltage reading does not immediately follow vacuum change, MAP sensor is faulty.

MAP SENSOR VOLTAGE RANGE

Altitude (Ft.)	Range (Volts)
Below 1000	3.8-5.5
1000-2000	3.6-5.3
2000-3000	3.5-5.1
3000-4000	3.3-5.0
4000-5000	3.2-4.8

5000-6000	3.0-4.6
6000-7000	2.9-4.5
7000-8000	2.8-4.3
8000-9000	2.6-4.2
9000-10,000	2.5-4.0

OXYGEN SENSOR (O2S)

1. Start engine and warm to operating temperature. Disconnect oxygen sensor. Connect DVOM between Purple wire of oxygen sensor and ground. Place DVOM on 2-volt scale.
2. Using another DVOM on 20-volt scale, connect DVOM in series between Purple wire from PCM/VCM and positive post of battery. This will simulate a rich condition, causing PCM/VCM to respond by leaning mixture. Reading on DVOM connected to oxygen sensor should decrease to less than .3 volt.
3. Move DVOM lead from positive battery post to negative battery post. This will simulate a lean condition, causing PCM/VCM to respond by richening mixture. Reading on DVOM connected to oxygen sensor should increase to greater than .8 volt. If reading does not change as specified, replace oxygen sensor.
4. If a second DVOM is not available, connect a jumper in Purple wire from PCM/VCM. Hold jumper in one hand and touch positive post of battery with other hand to simulate a rich condition. Touch negative post of battery to simulate a lean condition. For additional testing procedures, see the **TESTS W/CODES - 2.2L** article.

OXYGEN SENSOR HEATING ELEMENT

On models with oxygen sensor heating elements, disconnect 3-wire connector at oxygen sensor. Measure resistance between White wire terminals on sensor side of connector. Resistance should be 3.5-14 ohms at 68°F (20°C). If resistance is not 3.5-14 ohms, replace oxygen sensor.

THROTTLE POSITION (TP) SENSOR

1. Install jumper wires to enable connection of a DVOM in parallel between TP sensor harness connectors. Connect DVOM positive lead to Dark Blue wire terminal. Connect negative lead to Black wire terminal. See **Fig. 1** .
2. Turn ignition on, engine off. Slowly depress accelerator pedal. Signal voltage should gradually change from less than one volt at closed throttle to about 5.0 volts at wide open throttle position. If reading is not as specified, replace TP sensor.
3. TP sensor circuit malfunction should set a related trouble code. For further information, see the **TESTS W/CODES - 2.2L** article. Also see TP SENSOR ADJUSTMENT in the **ADJUSTMENTS - 2.2L** article.

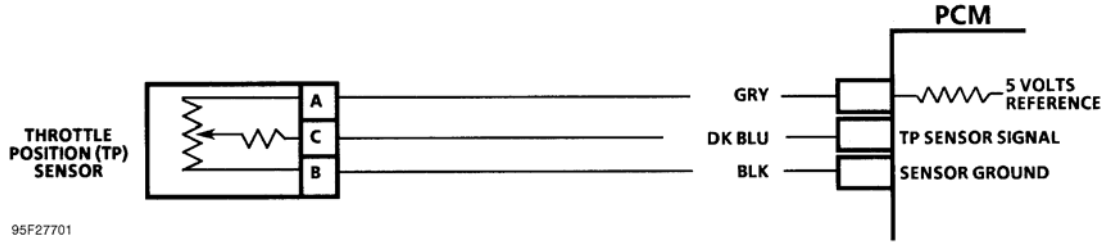

Fig. 1: Typical Throttle Position (TP) Sensor Circuit
Courtesy of GENERAL MOTORS CORP.

TRANSMISSION RANGE SWITCH

A problem in transmission range switch circuit will set related diagnostic trouble code. See the **TESTS W/CODES - 2.2L** article.

VEHICLE SPEED SENSOR (PM GENERATOR)

Disconnect vehicle speed sensor harness connector (located in transmission/transaxle). Place gear selector in Neutral. Raise vehicle drive wheels off the ground. Turn drive wheels by hand (more than 3 MPH). Measure AC signal voltage between sensor terminals. Voltage reading should vary from 0.1 to 0.5 volt AC as wheel is turned. If reading is not as specified, replace vehicle speed sensor. If a code is set, refer to the **TESTS W/CODES - 2.2L** article.

MODULES, MOTORS, RELAYS & SOLENOIDS

RELAYS

NOTE: To perform the following tests, use the WIRING DIAGRAMS article.

A/C Clutch Relay

See **MISCELLANEOUS PCM/VCM CONTROLS** .

Fuel Pump Relay

1. If a prolonged crank is required to start vehicle, fuel pump relay may be faulty. To verify, start engine. With engine running, disconnect oil pressure switch (fuel pump back-up circuit). If engine stalls, fuel pump relay is faulty. If vehicle continues to run, relay is okay. Check for other causes of prolonged crank.
2. To test fuel pump relay, disconnect fuel pump relay. Refer to **COMPONENT LOCATIONS** . Apply battery voltage and ground to fuel pump relay winding terminals (control and ground).
3. Using an ohmmeter, check continuity between fuel pump relay control and ground terminals. Continuity should exist. If continuity does not exist, fuel pump relay is defective.
4. To by-pass fuel pump relay on vehicle (fuel pump not operating), turn ignition off. Disconnect fuel pump relay connector. Using a fused jumper wire, connect fuel pump test connector to positive side of battery.

Fuel pump should run.

5. If fuel pump runs, check for faulty connections to relay or replace defective relay. To locate fuel pump test connector, refer to **COMPONENT LOCATIONS** .

SOLENOIDS

NOTE: All PCM/VCM-controlled solenoids should have at least 20 ohms of resistance (except fuel injectors).

Canister Purge Solenoid

See **EMISSION SYSTEMS & SUB-SYSTEMS** .

Idle Air Control (IAC) Valve

See **IDLE CONTROL SYSTEM** under FUEL SYSTEM.

Torque Converter Clutch (TCC) Solenoid

See **MISCELLANEOUS PCM/VCM CONTROLS** .

FUEL SYSTEM

FUEL DELIVERY

NOTE: For fuel system pressure testing, see the BASIC TESTING - 2.2L article.

Fuel Pressure Regulator (SFI)

Fuel pressure regulator is a vacuum-controlled diaphragm type, which uses manifold vacuum to modify fuel pressure to compensate for engine load fuel requirements. Connect fuel pressure gauge to fuel pressure service port. Start engine and note fuel pressure. Disconnect vacuum hose from fuel pressure regulator. Fuel pressure should increase 4-10 psi (.28-.70 kg/cm^2). If pressure does not increase 4-10 psi (.28-.70 kg/cm^2), check for presence of manifold vacuum at signal line. If vacuum is not present, check for kinked, cut or split vacuum hose or plugged throttle body vacuum port. If vacuum is present and no pressure change occurs, replace fuel pressure regulator.

Fuel Pump Oil Pressure Switch (Back-Up Circuit)

To test fuel pump oil pressure switch (fuel pump back-up circuit), start engine. With engine running, disconnect fuel pump relay. If engine stalls, fuel pump oil pressure switch is faulty. If vehicle continues to run, switch is okay.

Fuel Pump Relay

See FUEL PUMP RELAY under **MODULES, MOTORS, RELAYS & SOLENOIDS** .

Fuel Pump Relay By-Pass Procedure

If fuel pump will not energize, relay may be by-passed to test fuel pump. Turn ignition off. Using a fused jumper wire, apply battery voltage to fuel pump test connector. Fuel pump should turn on. For fuel pump test connector location, refer to **COMPONENT LOCATIONS** .

FUEL CONTROL

SFI Fuel Injector(s)

Disconnect fuel injector harness connector. Measure resistance across injector terminals. Resistance should be as specified. See SFI FUEL INJECTOR RESISTANCE table.

SFI FUEL INJECTOR RESISTANCE

Application	(1) Resistance (Ohms)
2.2L	11.6-12.4
(1) Injector resistance specification is at 140°F (60°C).	

Oxygen Sensor (O2S)

See **ENGINE SENSORS & SWITCHES** .

NOTE: If injectors are dirty, they should be cleaned using approved injector cleaning procedure before performing fuel INJECTOR BALANCE TEST.

Port Fuel Injector Balance Test (SFI)

The injector balance test is used to pulse the injector for a precise amount of time, spraying a measured amount of fuel in the intake manifold. As each injector is pulsed, a drop in fuel rail pressure occurs. This pressure drop can be recorded and compared to other injectors. All injectors should have a pressure drop of 1.5 psi (.11 kg/cm^2) or less. If pressure drop is more or less than other injectors, replace appropriate injector.

NOTE: Allow engine to cool to avoid irregular readings due to "hot soak" fuel boiling. To prevent flooding, INJECTOR BALANCE TEST should not be repeated more than once without starting and running engine.

1. Turn ignition off. Connect Fuel Pressure Gauge (J-39021-301) to pressure tap. Unplug harness connector at all injectors. Connect Injector Switch Box (J-39021-210) to one of the injectors.
2. Follow manufacturer's instructions when installing adapter harness. Ignition should be turned off at least 10 seconds to complete PCM/VCM shutdown cycle.
3. Turn ignition on. Fuel pump should run at least 2 seconds after ignition is turned on. Bleed air from gauge and hose to ensure accurate gauge reading. Repeat this procedure until all air is bled from system. Turn ignition off for at least 10 seconds.
4. Turn ignition on again to bring fuel pressure to maximum. Record initial pressure reading. Energize

switch box one time and note pressure drop at lowest point.

5. Disregard any slight pressure drop after low point is reached. Subtracting second pressure reading from initial reading indicates amount of injector pressure drop.
6. Repeat step 4) on each injector and compare pressure drop. Recheck injectors not within pressure drop range. Replace injector(s) failing second check. If injectors are all okay, plug in harness connectors and review SYMPTOMS in the **TESTS W/O CODES - 2.2L** article.

IDLE CONTROL SYSTEM

Idle Air Control (IAC) Valve

1. Disconnect harness connector to motor. Check resistance across IAC coil terminals "A" to "B" and "C" to "D". See **Fig. 2** . Resistance should be 40-80 ohms. If okay, go to next step. If resistance is not as specified, replace IAC valve.
2. Check resistance between IAC terminals "B" to "C" and "A" to "D". Resistance should be infinite. If resistance is not as specified, replace IAC valve.

NOTE: Functional testing of Idle Air Control (IAC) valve requires a bidirectional scan tool capable of cycling PCM/VCM output devices or a special IAC Driver and Noid Light Set (222L or J-37027). Text in TESTS W/CODES - 2.2L article may refer to Tech 1 tester, General Motor's bidirectional scan tool.

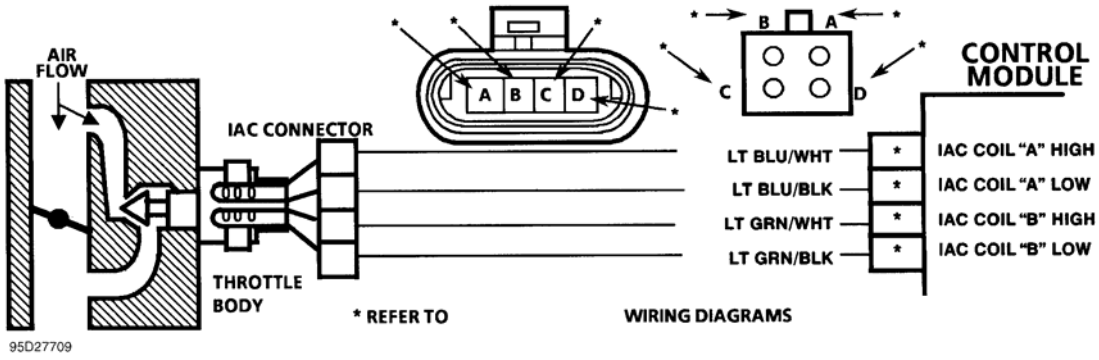

Fig. 2: Identifying IAC Valve Circuits (Typical)
Courtesy of GENERAL MOTORS CORP.

IGNITION SYSTEM

NOTE: For basic ignition system checks, see the BASIC TESTING - 2.2L article.

TIMING CONTROL SYSTEMS

Ignition Control Circuit

An open or short to ground in Ignition Control (IC) or by-pass circuit will cause PCM/VCM to turn on Malfunction Indicator Light (MIL) and confirm fault by setting a related trouble code. Refer to the **TESTS W/CODES - 2.2L** article.

Knock Sensor Circuit (Models Using External Spark Controller Module)

1. An open or short circuit on IC module control wire to PCM/VCM will cause a loss of 12-volt IC module signal. This will cause PCM/VCM to fully retard ignition timing.
2. If a scan tool is available, connect tester to Data Link Connector (DLC). Using a metal object, tap on engine next to knock sensor and note knock parameter. Knock should be indicated on scan tool.
3. If a scan tool is not available, backprobe PCM/VCM knock sensor signal terminal with a DVOM. With engine idling, 8-12 volts should be present at this terminal. Using a metal object, tap on engine close to knock sensor. Voltage signal at PCM/VCM terminal should drop to zero volts, and return to original voltage when knock signal ceases.
4. If voltage signal does not respond as described, check knock sensor-to-module-signal. On vehicles equipped with automatic transmission, it may be necessary to place transmission in Drive for timing change to occur. See KNOCK SENSOR under **ENGINE SENSORS & SWITCHES** .

Knock Sensor Circuit (Models Using Knock Sensor With Internal Spark Controller Module)

1. An open or short circuit on knock sensor wire to PCM/VCM will set a related trouble code. A false detonation signal will not cause PCM/VCM to set a code.
2. If a scan tool is available, connect it to Data Link Connector (DLC). Tap on engine next to knock sensor and note "knock" parameter. Knock should be indicated on scan tool.
3. If a scan tool is not available, connect tachometer to engine. Start engine and hold RPM above idle. Using a metal object, tap on engine close to knock sensor. A noticeable decrease in engine RPM should occur. If no RPM decrease occurred, check knock sensor to PCM/VCM circuit.
4. On vehicles equipped with automatic transmission, it may be necessary to place transmission in Drive for timing change to occur. See KNOCK SENSOR under **ENGINE SENSORS & SWITCHES** .

EMISSION SYSTEMS & SUB-SYSTEMS

EXHAUST GAS RECIRCULATION

Linear EGR Valve (Digital Valve)

1. Install scan tool. Ensure transmission range switch is operating properly. See **ENGINE SENSORS & SWITCHES** . With engine at normal operating temperature, command EGR pintle position to zero percent. Increase engine speed to 2000 RPM. If scan tool reads actual EGR pintle position at greater than 3 percent, EGR valve is stuck open. Replace EGR valve.
2. If scan tool reads actual EGR pintle position at 3 percent or less, command a 25 percent position step increase (i.e. 0-25 percent, 25-50 percent, 50-75 percent, etc.). Observe MAP reading and actual EGR pintle position for 3 seconds. EGR should increase by about 25 percent position and MAP reading should also increase.
3. If actual EGR pintle position is stable and within 10 percent of desired EGR pintle position command

after 2 seconds, go to next step. If actual EGR pintle position is not as specified, go to step 5).

4. MAP reading should have increased when EGR pintle responded. If MAP did not respond, check EGR passages and EGR valve for blockage. If MAP responded, set desired EGR pintle position to 100 percent. If EGR pintle position sets to 100 percent, EGR is okay. If not, replace EGR valve.
5. Turn engine off. Check EGR electrical circuit and connecting components. Turn ignition on, check for 5-volt reference voltage on harness connector terminal "D" (Gray wire). If 5-volt reference voltage is not present, check PCM/VCM. See **CONTROL UNIT** under COMPUTERIZED ENGINE CONTROLS. If circuits are okay, replace EGR valve.

FUEL EVAPORATION CONTROL

EVAP Control System

A problem in the EVAP control system will set a Diagnostic Trouble Code (DTC). See the **TESTS W/CODES - 2.2L** article.

POSITIVE CRANKCASE VENTILATION

Required Service

The PCV system may require service for obstructions if any of the following conditions exist:

- Rough Idle
- Stalling or Low Idle Speed
- Oil Leaks
- Oil in Air Cleaner
- Sludge in Engine

A leaking PCV valve or hose could cause:

- Rough Idle
- Stalling
- High Idle Speed

If engine idles roughly, check for clogged PCV valve and for plugged or broken PCV hoses BEFORE adjusting idle. Check for correct PCV valve application to ensure the correct valve is fitted. Replace PCV valve if required.

Checking PCV Valve Function

1. Remove PCV valve from rocker cover. Run engine at idle. Place thumb over open end of valve to check for vacuum. If there is no vacuum at valve, check for obstruction in manifold port, hoses or PCV valve. Repair or replace as necessary.
2. Turn engine off. Remove PCV valve. Shake valve and listen for rattle of check valve inside PCV valve. If a clear rattle is not heard, replace PCV valve.

3. Visually inspect valve for varnish or deposits that may make PCV valve sticky, restricted or incompletely seated. Replace if necessary.
4. Engine must be sealed for PCV system to function as designed. If leakage, sludging or dilution of oil is noted and PCV system is functioning properly, check engine for cause and repair as required to ensure PCV system will continue to function properly.
5. Since an engine operating without any crankcase ventilation can be damaged, it is important to replace PCV valve and air cleaner breather at regular intervals (at least every 30,000 miles). Check all hoses and clamps for failure or deterioration.

MISCELLANEOUS PCM/VCM CONTROLS

NOTE: Although not considered true engine performance-related systems, some controlled devices may affect driveability if they malfunction.

TRANSMISSION

NOTE: To perform the following tests, use appropriate wiring diagram in the WIRING DIAGRAMS article.

Torque Converter Clutch (TCC) Solenoid

Disconnect harness connector to TCC solenoid. Measure resistance between TCC solenoid terminals. Solenoid resistance should be 10-15 ohms at 68°F (20°C).

NOTE: Some solenoids have an internal pressure switch in series with solenoid winding and will not show continuity until transmission hydraulic pressure is applied.

Converter Lock-Up Signal At Transmission

1. Warm engine to operating temperature. Raise vehicle and support drive wheels. Support suspension where necessary to prevent damage to drive axles.
2. Disconnect converter clutch connector at transmission. Connect a test light across converter clutch harness terminals. Start engine and place transmission in Drive. Accelerate vehicle to 45 MPH and note test light.
3. If test light is not on, check solenoid power supply wire of harness for open or short to ground. Check ground circuit for open between harness connector and PCM/VCM. If harness is okay, see CONVERTER LOCK-UP SIGNAL FROM PCM/VCM.

Converter Lock-Up Signal From PCM/VCM

1. Warm engine to operating temperature. Raise vehicle and support drive wheels. Support suspension where necessary to prevent damage to drive axles.
2. Connect a test light to battery voltage. Touch TCC control driver terminal with test light. Accelerate

vehicle to 45 MPH and note test light. If test light does not illuminate, problem is a faulty PCM/VCM connector or PCM/VCM.

Shift Light (Manual Transmission)

1. These tests assume a shift light problem exists. Use this procedure only if the light will not illuminate, or illuminates all the time.
2. Turn ignition on, with engine off. Note shift light. Shift light should not be on. If shift light is on, check for a short to ground between bulb and PCM/VCM or for bad PCM/VCM.
3. Turn ignition on, with engine off, ground test terminal No. 2 (Purple wire) of Data Link Connector (DLC). Malfunction Indicator Light (MIL) should flash and shift light should come on. If MIL illuminates, go to next step. If MIL does not flash, perform ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK in the **BASIC TESTING - 2.2L** article.
4. If shift light does not come on, ground Tan/Black light driver wire at PCM/VCM terminal using a jumper wire. For circuit identification, see SHIFT LIGHT CIRCUIT IDENTIFICATION table. See **Fig. 3** .
5. If shift light still does not come on, check for blown GAGES fuse, blown bulb or open circuit between fuse and PCM/VCM. If shift light illuminates when grounding PCM/VCM terminal with a jumper wire, problem is a bad PCM/VCM connection or bad PCM/VCM.

SHIFT LIGHT CIRCUIT IDENTIFICATION

Application	VCM Connector (Terminal No.)
2.2L	C2 (50)

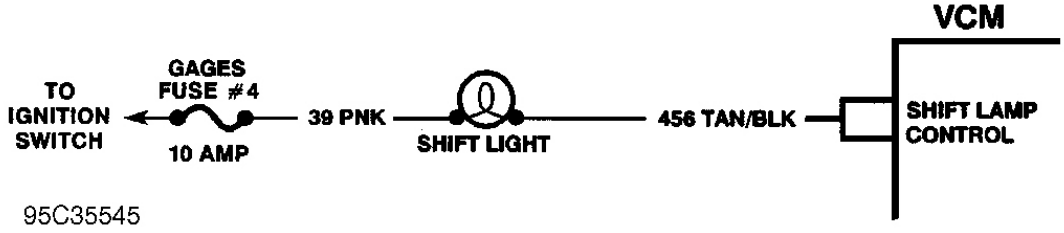

Fig. 3: Typical Shift Light Circuit
Courtesy of GENERAL MOTORS CORP.

PCM CONTROLLED WARNING LIGHTS & GAUGES

Warning Light Diagnosis

1. Perform On-Board Diagnostics (OBD) system check. See ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK in the **BASIC TESTING - 2.2L** article. After performing OBD system check, go to next step.
2. Check instrument cluster. See the INSTRUMENT PANEL article in the ACCESSORIES/SAFETY EQUIPMENT section. If instrument panel is okay, go to next step.
3. Turn ignition off. Disconnect PCM connector. Turn ignition on. Using a DVOM, check voltage between

affected PCM output circuit at PCM harness connector terminal and ground. See the WIRING DIAGRAMS article. Battery voltage should be present. If battery voltage is present, go to next step. If battery voltage was not present, go to step 7).

4. Set DVOM to 10-amp scale. Check current between affected PCM output circuit and ground. Monitor reading for about 2 minutes. DVOM should read .05-1.50 amps. If reading is as specified, go to step 12). If reading is not as specified, go to next step.
5. Disconnect instrument cluster, leaving PCM connector disconnected. Using DVOM, check voltage between affected PCM output circuit and ground. DVOM should read zero volts. If voltage reading is as specified, go to step 15). If voltage reading is not as specified, go to next step.
6. Locate and repair short to voltage in affected PCM output circuit. After repairs, go to step 17).
7. Check ignition feed fuse for instrument cluster indicator lights. If fuse is blown, go to next step. If fuse is okay, go to step 9).
8. Locate and repair short to ground in ignition feed circuit for instrument cluster indicator lights. Replace fuse and go to step 17).
9. Disconnect instrument cluster connector. Turn ignition on. Check voltage between ignition feed circuit for instrument cluster indicator lights and ground. Battery voltage should be present. If battery voltage is present, go to next step. If battery voltage was not present, go to step 14).
10. Check affected PCM output circuit for an open or shorted circuit to ground. If circuit is open or shorted, go to step 17). If circuit was okay, go to next step.
11. Check affected PCM output circuit and ignition feed circuit for poor connection at instrument cluster and at PCM. If problem is present, repair as necessary and then go to step 17). If problem was not found, go to step 15).
12. Turn ignition off. Reconnect PCM harness connector. Disconnect instrument cluster connector. Turn ignition on. Connect a test light between affected PCM output circuit and ignition feed circuit at instrument panel harness connector. Using a scan tool, perform OUTPUTS TEST function to cycle affected warning light on and off. If test light flashes on and off, check for shorted component or circuit in the output driver circuit. Check for faulty instrument cluster. If test light does not flash on and off, go to next step.
13. Check affected PCM output circuit for poor connection to PCM. Replace defective terminal and then go to step 17). If terminal is okay, go to step 16).
14. Repair open in ignition feed circuit to instrument cluster indicator lights. After repairs, go to step 17).
15. Replace instrument cluster and then go to step 17).
16. Replace PCM and then go to next step.
17. Using scan tool, operate affected warning light. If warning light does not operate properly, go to step 3).

Tachometer Control Circuit Diagnosis

1. Diagnose instrument cluster. See the INSTRUMENT PANEL article in the ACCESSORIES/SAFETY EQUIPMENT section. After diagnosis, go to next step.
2. Perform On-Board Diagnostic (OBD) system check. See ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK in the **BASIC TESTING - 2.2L** article. After performing OBD system check, go to next step.
3. Turn ignition off. Disconnect PCM connector. Turn ignition on. Using a DVOM, check voltage between tachometer control circuit at PCM harness connector terminal and ground. See the WIRING DIAGRAMS

article. Battery voltage should be present. If battery voltage is present, go to next step. If battery voltage was not present, go to step 7).

4. Set DVOM to 10-amp scale. Check current between tachometer control circuit and ground. Monitor reading for about 2 minutes. DVOM should read .05-1.50 amps. If reading is not as specified, go to next step. If reading is as specified, go to step 12).
5. Disconnect instrument cluster, leaving PCM connector disconnected. Using DVOM, check voltage between tachometer control circuit and ground. DVOM should read zero volts. If voltage reading is as specified, go to step 15). If voltage reading is not as specified, go to next step.
6. Locate and repair short to voltage in tachometer control circuit. After repairs, go to step 17).
7. Check ignition feed fuse for instrument cluster. If fuse is blown, go to next step. If fuse is okay, go to step 9).
8. Locate and repair short to ground in ignition feed circuit to instrument cluster. Replace fuse and go to step 17).
9. Disconnect instrument cluster connector. Turn ignition on. Check voltage between ignition feed circuit for instrument cluster and ground. Battery voltage should be present. If battery voltage was not present, go to step 14). If battery voltage is present, go to next step.
10. Check tachometer control circuit for an open or shorted circuit to ground. If circuit is open or shorted, go to step 17). If circuit was okay, go to next step.
11. Check tachometer control circuit and ignition feed circuit for poor connection at instrument cluster and at PCM. If problem is present, repair as necessary and then go to step 17). If problem was not found, go to step 15).
12. Turn ignition off. Reconnect PCM harness connector. Disconnect instrument cluster connector. Turn ignition on. Connect a test light between tachometer control circuit and ignition feed circuit at instrument panel harness connector. Using a scan tool, perform OUTPUTS TEST function to cycle tachometer control output light on and off. If test light flashes on and off, check for shorted component or circuit in the output driver circuit. Check for faulty instrument cluster. If test light does flash on and off, go to next step.
13. Check tachometer control circuit for poor connection to PCM. Replace defective terminal and then go to step 17). If terminal is okay, go to step 16).
14. Repair open in ignition feed circuit to instrument cluster. After repairs, go to step 17).
15. Replace instrument cluster and then go to step 17).
16. Replace PCM and then go to next step.
17. Start engine and observe tachometer. If tachometer does not operate properly, diagnose instrument cluster. See the INSTRUMENT PANEL article in the ACCESSORIES/SAFETY EQUIPMENT section.

A/C COMPRESSOR CLUTCH CONTROLS

The A/C compressor clutch relay is controlled by the PCM. The PCM improves idle quality by delaying A/C compressor clutch engagement until idle speed is increased, or disengages A/C compressor clutch when idle speed is too low. A/C compressor clutch is cycled by PCM. PCM smooths cycling of A/C compressor clutch by adding fuel the instant A/C compressor clutch is applied.

NOTE: See the WIRING DIAGRAMS article for component location, terminal and wire

color identification.

RELAY LOCATION

A/C COMPRESSOR CLUTCH RELAY LOCATION

Application	Location
S/T Series	In Engine Compartment, On Bracket At Center Of Firewall

WARNING: Vehicles may be equipped with a PCM using an Electronically Erasable Programmable Read Only Memory (EEPROM). When replacing PCM, the new PCM must be programmed.

NOTE: To help save diagnostic time, ALWAYS check for blown fuses or fusible links before proceeding with any testing. If fuses are blown, locate and repair short circuit before replacing fuses. Ensure all related relay and wire harness connections are clean and tight. Repair as necessary.

A/C CLUTCH CIRCUIT DIAGNOSIS

Description

PCM receives an A/C request signal from Instrument Panel Cluster (IPC) over serial data line. When A/C is requested, PCM provides a ground path to A/C clutch relay control circuit. When relay circuit is grounded, A/C compressor clutch relay is energized. After A/C request has been selected, PCM will delay grounding A/C compressor relay control circuit for .3 second. This allows PCM to adjust engine idle RPM for additional load.

PCM will temporarily de-energize A/C compressor clutch relay for a hot engine restart, wide open throttle, engine speed greater than 6000 RPM, or Idle Air Control (IAC) valve reset. A/C compressor clutch relay will remain de-energized when a Diagnostic Trouble Code (DTC) P0530 is set, or there is no A/C request signal due to an open A/C select switch circuit.

Compressor Clutch Control Circuit Diagnosis

1. If On-Board Diagnostic (OBD) System Check has not been performed, see the **BASIC TESTING - 2.2L** article and go to OBD SYSTEM CHECK. If OBD SYSTEM CHECK has been performed, go to next step.
2. Install scan tool. Check if DTC P0530 is set. If DTC P0530 is set, see the **TESTS W/CODES - 2.2L** article. If DTC P0530 is not set, go to next step.
3. Turn ignition on, engine off. Check if A/C compressor clutch is engaged. If A/C compressor clutch is engaged, go to next step. If A/C compressor clutch is not engaged, go to step 5).
4. Disconnect A/C relay. If A/C compressor clutch disengages, go to step 6). If A/C compressor clutch does not disengage, go to step 7).
5. Start engine and allow it to reach normal operating temperature. Cycle A/C selector switch on, then off. If A/C compressor clutch cycles on, then off, go to step 8). If A/C compressor clutch does not cycle on, then off, go to step 9).

6. Using a test light connected to battery voltage, probe A/C relay control circuit terminal (Dark Green/White wire). If test light illuminates, go to step 10). If test light does not come on, go to step 11).
7. Disconnect A/C compressor clutch harness connector. If A/C compressor clutch disengages, go to step 12). If A/C compressor clutch does not disengage, go to step 13).
8. Turn ignition on, engine off. Install A/C manifold gauge set. Observe A/C high-side pressure readings on gauge set and scan tool. If high-side pressure readings are within 20 psi (1.4 kg/cm^2) of each other, go to step 36). If pressures are not as specified, go to step 14).
9. Turn A/C on, then off. If scan tool indicates that A/C was requested, then not requested, go to step 15). If operation is not as specified, go to step 16).
10. Check A/C compressor clutch relay control circuit (Dark Green/White wire) for a short to ground. Repair as necessary. Go to step 36). If no problem is found, go to step 22).
11. Replace A/C compressor clutch relay. Go to step 36).
12. Repair short to power in A/C compressor clutch ignition feed circuit (Dark Green wire). Go to step 36).
13. Replace faulty A/C compressor clutch assembly. Go to step 36).
14. Turn ignition on, engine off. Disconnect A/C refrigerant pressure sensor harness connector. Using a voltmeter, measure voltage between battery positive and Black wire at A/C refrigerant pressure sensor harness connector. If reading is battery voltage, go to step 18). If reading is not as specified, go to step 19).
15. With ignition on, engine off, observe A/C HIGH-SIDE pressure reading on scan tool. If reading is 40-430 psi (2.8-30.2 kg/cm^2), go to step 20). If reading is not as specified, go to step 21).
16. Turn ignition off. Disconnect PCM harness connectors. Turn ignition on. Using a test light connected to ground, probe A/C selector switch input circuit (Light Green wire) at PCM harness connector. Cycle A/C selector switch on, then off. If test light toggles on, then off, go to next step. If operation is not as specified, go to step 23).
17. Check Light Green wire for a poor connection at PCM. Repair as necessary. Go to step 36). If no problem is found, go to step 22).
18. Replace A/C refrigerant pressure sensor. Go to step 36).
19. Repair open or poor connection in A/C refrigerant pressure sensor ground circuit (Black wire). Go to step 36).
20. Disconnect A/C relay. Using a test light connected to ground, probe A/C relay ignition feed circuits (Orange and Pink wires). If test light comes on for both circuits, go to step 24). If test light does not come on for both circuits, go to step 25).
21. Install A/C manifold gauge set. With ignition on, engine off, observe A/C high-side pressure readings on gauge set and scan tool. If high-side pressures are within 20 psi (1.4 kg/cm^2) of each other, diagnose A/C-heater system. If high-side pressures are not as specified, go to step 18).
22. Replace PCM. Go to step 36).
23. Repair A/C request signal circuit (Light Green wire) from A/C selector switch. Go to step 36).
24. Connect a fused jumper wire between A/C relay harness connector cavities No. 87 (Orange wire) and No. 30 (Dark Green wire). If A/C compressor clutch engages, go to step 26). If A/C compressor clutch does not engage, leave jumper wire installed and go to step 27).
25. If test light did not come on at Orange wire, check for a short to ground in A/C compressor clutch ignition

feed circuit (Dark Green wire), or for a faulty A/C compressor clutch diode. Repair as necessary. Go to step 36). If no problem is found, go to step 28).

26. Remove jumper wire. Start engine and let idle. Using a test light connected to battery positive, probe A/C relay harness connector cavity No. 85 (Dark Green/White wire). Using scan tool, command A/C relay on. If test light comes on, go to step 11). If test light does not come on, go to step 29).
27. Disconnect A/C compressor clutch harness connector. Using a test light connected to ground, probe Dark Green wire at A/C compressor clutch harness connector. If test light comes on, go to step 30). If test light does not come on, go to step 31).
28. Repair open in Orange wire or Pink wire to A/C relay. After repairs, go to step 36).
29. Using a test light connected to ground, probe A/C relay harness connector cavity No. 85 (Dark Green/White wire). If test light comes on, go to step 32). If test light does not come on, go to step 33).
30. Using a test light connected to battery positive, probe A/C compressor clutch ground circuit (Black wire) at A/C compressor clutch harness connector. If test light comes on, go to step 34). If test light does not come on, go to step 35).
31. Repair open in A/C compressor clutch ignition feed circuit (Dark Green wire). Go to step 36).
32. Check A/C compressor clutch relay control circuit (Dark Green/White wire) for a short to power. Repair as necessary. Go to step 36). If no problem is found, go to step 17).
33. Check A/C compressor clutch relay control circuit (Dark Green/White wire) for an open or poor connection. Repair as necessary. Go to step 36). If no problem is found, go to step 17).
34. Replace A/C compressor clutch coil. Go to step 36).
35. Repair open or poor connection in A/C compressor clutch ground circuit (Black wire). Go to next step.
36. Start engine and let idle. Cycle A/C selector switch on, then off. If A/C compressor clutch cycles on, then off, system is okay at this time. See DIAGNOSTIC AIDS. If operation is not as specified, go to step 2).

Diagnostic Aids

If DTC P0530 is set, do not perform this diagnostic procedure. Diagnose appropriate DTC before proceeding. See the **TESTS W/CODES - 2.2L** article.

A/C refrigerant pressure less than 43 psi (3.0 kg/cm^2), or greater than 428 psi (30.1 kg/cm^2) will cause PCM to disable A/C compressor clutch. With engine running and A/C on, use scan tool to monitor A/C high-side system pressure for 2 minutes. If pressure goes out of range, diagnose A/C-heater system.

COMPONENT LOCATIONS

COMPONENT LOCATIONS

Component	Location
A/C Compressor Relay	Center Rear Of Engine Compartment
A/C Pressure Sensor	At A/C Evaporator
Camshaft Position (CMP) Sensor	Right Side Of Engine Forward Of Coil Packs
Crankshaft Position (CKP) Sensor	Right Side Of Engine Below Coil

	Packs
Data Link Connector (DLC)	Lower Left Side Of Instrument Panel
EGR Valve	Top Rear Of Engine
Electronic Ignition Control Module	Right Side Of Engine Near Camshaft Position Sensor
Engine Coolant Temperature (ECT) Sensor	Front Of Engine Near Thermostat Housing
Engine Oil Pressure Gauge/Fuel Pump Switch	Right Side Of Engine Near Camshaft Position Sensor
EVAP Canister Purge Solenoid	Right Rear Side Of Engine Above Coil Packs
EVAP Canister Vent Solenoid	Crossmember Area Of Fuel Tank
Fuel Injectors	Right Rear Side Of Engine On Fuel Rail
Fuel Level Sensor	Top Of Fuel Tank
Fuel Pump Prime Connector	Left Rear Side Of Engine Compartment
Fuel Pump Relay	In Relay Center Behind Glove Compartment
Fuel Tank Pressure Sensor	Top Of Fuel Tank
Idle Air Control (IAC) Valve	Top Right Side Of Engine
Intake Air Temperature (IAT) Sensor	Left Front Of Engine Compartment On Air Intake Duct
Knock Sensor	Lower Right Side Of Engine Below Coil Packs
Manifold Absolute Pressure (MAP) Sensor	Top Right Side Of Engine On Intake Manifold
Oxygen Sensor (O2S)	
Pre-Converter	In Left Exhaust Manifold
Post-Converter (Heated)	Rear Of Catalytic Converter
Powertrain Control Module (PCM)	Right Side Of Engine Compartment
Relay Center	Behind Glove Compartment
Throttle Position (TP) Sensor	Top Right Side Of Engine
Vehicle Speed Sensor	Right Rear Of Transmission